DynaMetric, Inc.

2955 EAST COLORADO BLVD. • PASADENA, CALIF. • SYCAMORE 5-9123

Mailed in

5 May 1960

Dear Doc:

Attached are my thoughts on the problem of how to decide what focal length should be used in the particular design. I hope this proves useful to you. There doesn't seem to be any way of getting at a firm fix on the focal length problem because it involves the decision as to what comprises a practical film resolution and what comprises a practical camera configuration. It seems to me the best you can do is as outlined in the attached review.

Regards,

STAT

DynaMetric, Inc.
PASADENA, CALIF.

Review of Focal Length vs. Ground Resolution vs. Resolution on Film

Basis of Choice of Focal Length

Job 42

5 May 60

WCM

The problem of making a practical choice of the focal length necessary to achieve the maximum ground resolution and information content from a particular vehicle and flight plan can be approached as follows:

1. To get the lowest camera weight and size with the slowest cycling rate the shortest practical focal length should be used.

2. There is a limiting angular resolution achievable from a particular vehicle and flight plan. It is limited for many reasons such as thermal effects, turbulence, shock waves, window problems, vibration, IMC error, etc. At a particular angular resolution these effects result in the same degradation in ground resolution regardless of the combination of focal lengths and film resolution used.

3. Therefore, the choice of focal length is really one involving lens, film, processing and printing considerations rather than camera design. This is true if the short focal length is chosen on a practical basis so that a comparatively slow cycling, low weight, and small size camera can be achieved.

4. In deciding on focal length the basic decision is what is finest resolution that can be practically used on the film without requiring long exposure times (low emulsion sensitivity), excessive lens aperture, too precise a control of exposure, too critical processing and which will not result in excessive loss of data upon printing and enlargement. These choices change with the improvement of lenses, films, processing and printing techniques and equipment. A rough evaluation of this progress is as follows:

The finest practical film resolution around which aerial camera design choices could be made in the past are as follows:

Up to the Year 1954	- 25 lines per millimeter on the film
to the Year 1958	- 50 lines per millimeter on the film
At present	- 120 lines per millimeter on the film

As you can see, there has been enough recent improvement in lenses, films, processing and printing so that it is now possible to plan cameras around a film resolution of 120 lpm without loss of information content or resulting in impractical requirements on lenses, exposure time, processing or printing techniques.

DynaMetric, Inc.
PASADENA, CALIF.

Review of Focal Length vs. Ground Resolution vs. Resolution on Film

Basis of Choice of Focal Length

Job 42

5 May 60

WCM

5. Therefore, at present, it is merely necessary to establish the practical limit for angular resolution for the particular vehicle and flight plan. Having chosen this value, such as, .02 milradians, and having picked the practical film resolution useable, such as, 120 lpm, then the lens focal length required is fully determined. (See Chart, page 4.) It would be 18" for these values. Of course, other considerations enter in, such as, weight, coverage, cycling rate, available lenses, etc.

6. The nomograph on page 3 provides an easy correlation between focal length, lens resolution, angular resolution, ground resolution and altitude. The effect of the various choices of focal length, film resolution and angular resolution can be easily determined by using this diagram.

DynaMetric, Inc.
PASADENA, CALIF.

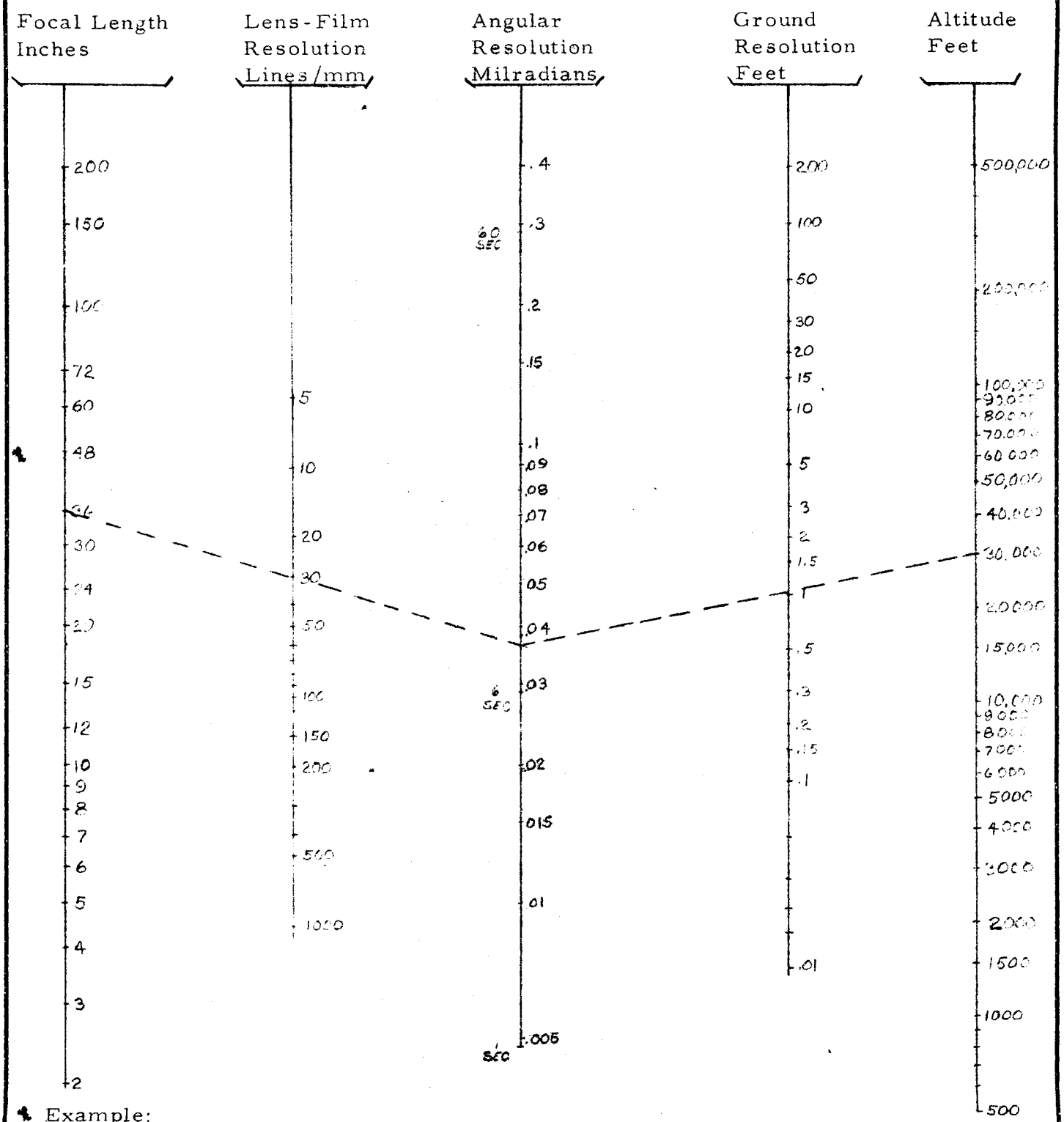
Job 42

5 May 60

WCM

Review of Focal Length vs. Ground Resolution vs. Resolution on Film

Nomograph - Focal Length - Resolution - Altitude



Example:

A 36-inch focal length lens which can produce 30 lines/mm on the film has an angular resolution of about .037 milradians. When flown at 30,000 feet altitude the ground resolution will be one foot.

DynaMetric, Inc.
PASADENA, CALIF.

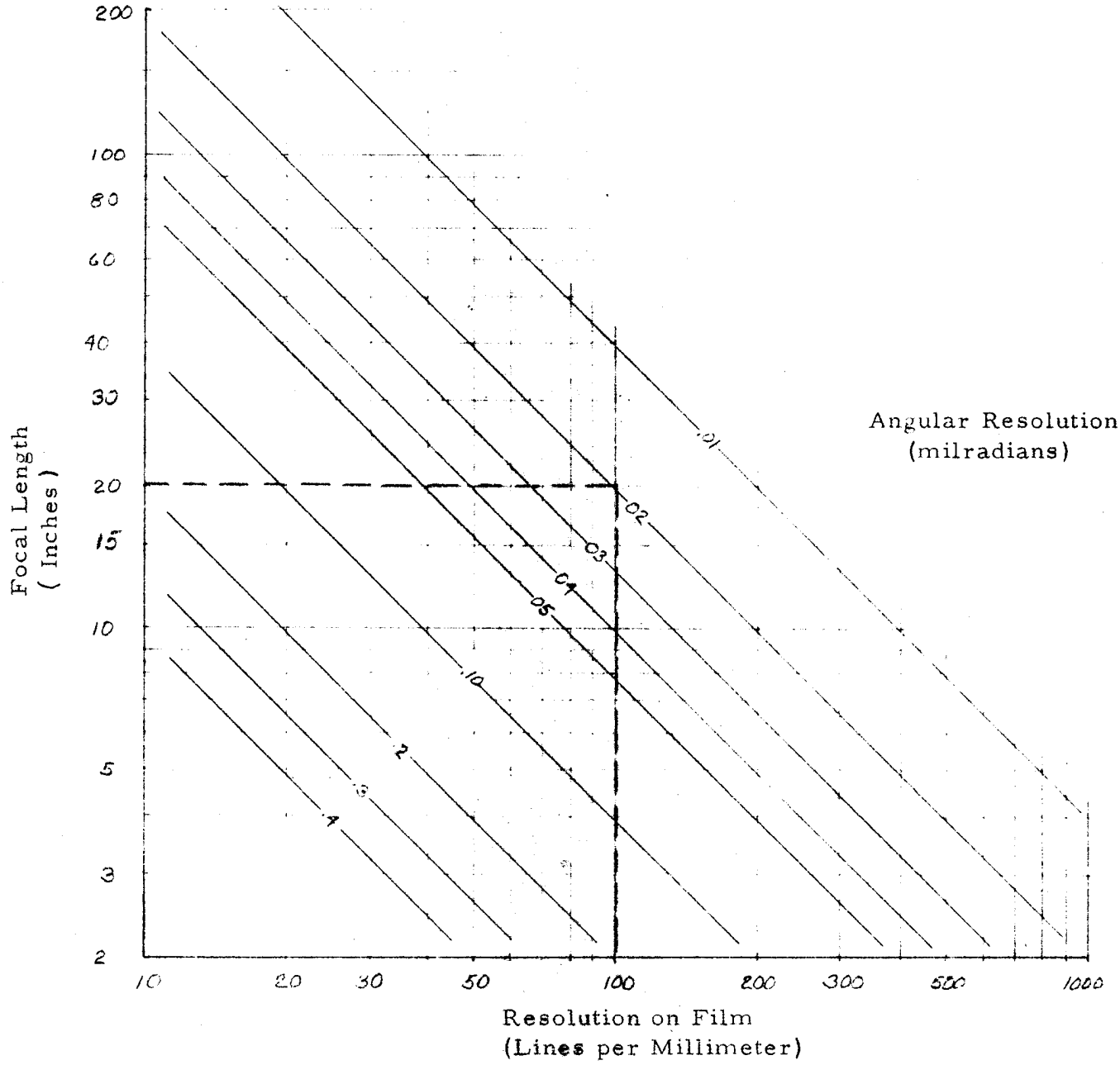
Job 42

5 May 60

WCM

Review of Focal Length vs. Ground Resolution vs. Resolution on Film

CHART - Focal Length vs. Film Resolution for Various Angular Resolutions



Example:

A 20-inch lens with 100 lpm on film will have an angular resolution of .02 milradians. Calculated ground resolution at 10,000 ft = 10,000 x .00002 = .2 ft on ground